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MVEE
(CHRISTCHURCH)

REPORT No. 70518

(INTERIM REPORT ISSUED AS MEXE TEST REPORT No. 1195)

175 mm SPECIAL - PURPOSE PALLET

by

J.P. FITZGERALD - SMITH
(PLANT ROADS AND AIRFIELDS BRANCH)

AUGUST 1970

MINISTRY OF DEFENCE
ARMY DEPARTMENT

MVEE (CHRISTCHURCH)
Barrack Road
Christchurch
Hants

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CONTENTS

MILITARY VEHICLES AND ENGINEERING ESTABLISHMENT, (~~CHRISTCHURCH~~)

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175 mm SPECIAL-PURPOSE PALLET

by

J. P. FitzGerald-Smith

(INTERIM REPORT ISSUED 29 JAN 70 AS MEXE TEST REPORT No. 1195)

MATERIALS HANDLING GROUP — PLANT, ROADS AND AIRFIELDS BRANCH

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Summary

The report describes the development work underlying the design of a timber special-purpose pallet (43in × 34 in — 1092 mm × 864 mm) to meet the recommendations of the AWSG Royal Artillery team.

The report concludes that the pallet can be designed to meet the handling stresses applied to this class of load in the field and peculiar to the vertical loading of the shells on the pallet.

A special expendable debanding tool has been developed at MVEE (Christchurch) to deal with the eight metal bands which might otherwise have been an objectionable feature of the design.

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MILITARY VEHICLES AND ENGINEERING ESTABLISHMENT (CHRISTCHURCH)

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175 mm SPECIAL-PURPOSE PALLET

(Interim Report issued on 29 Jan 70 as MEXE Test Report No. 1195)

Security Classification
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DFVE Project No. R 139

References

a. Army Works Study Group Report No. 21/1968:
Palletisation of 175 mm Ammunition by Royal Artillery Group

b. Minutes of meeting held at Bicester on 30 Oct 69.

Introduction

1. At the meeting held at Bicester on 30 Oct 69 it was concluded that:

a. The 3½ US Shell Pallets would be retained on a 43 × 34 in (1092 × 864 mm) Base Pallet.

b. An integral top board with a matrix of holes to suit a 5 × 4 arrangement of shells would be superimposed on the 3½ US Pallets.

c. A suitable sub-pallet, on the lines of one of the pallets that survived the Bicester test, would be used.

d. The design would not make it essential to remove the runners on the US Pallets.

e. A system of diagonal bracing holding the composite unit load together would be devised. (It was understood that this would only be removed at the gun site and that it would not be necessary to replace the bracing before a move.)

Design of pallet

2. At the suggestion of MHTU, the principle of a four-way entry was preserved and as many of the STANAG 2826 requirements met as possible. The MHTU design, when examined, was considered unlikely to meet safety requirements, with particular reference to the tendency of the nails to pull out at the ends when it attempted to behave as a composite beam (Fig 1). (The MVEE design uses wood screws at critical points where anchorage is important.) The safety criterion adopted was that, when the pallet and load were lifted by slings, it should comply with the same proof load as the slings themselves (100% overload). This was quite apart from the unit load being capable of surviving transit through the supply chain.

3. From the point of view of acceptance conditions to be applied to a contract for the manufacture of pallets, Tests 5 and 6 of BS 2629 : 1960 were used as the basis for designing members and arriving at dimensions. The design finally adopted is shown on MEXE Drawing No. 33104.

Design of unit load

4. Advantage was taken of the spacing between the shells to insert a 'figure-of-eight' banding — two parallel to the 43 in (1092 mm) side and two parallel to the 34 in (864 mm) side. It was found advisable to adopt the following sequence of banding:

a. Shells first banded to US Pallets — three rings of banding for each pallet of six, and one for the cut-down pallet of two.

b. The bored plywood top is then laid over the matrix of 5 × 4 shells, and acts as a template for their correct positioning.

c. The ply board is banded to the base, using two rings of banding parallel to the 43 in side and two rings of banding parallel to the 34 in side. One packing piece 34 × 3½ × 3½ in (864 × 89 × 89 mm) is necessary at the position indicated in Fig 2 to prevent the banding pulling the deck plank away from its support.

d. The figure-of-eight banding is threaded through the shells and tensioned in the middle of the top side. At this point both diagonal pulls are balanced. This can be seen in Figs 3 and 2.

Test of Pallets

5. An additional load, consisting of a 3 000 lb weight, was added to the weight of the shells, and the whole weight slung from under the wings of the pallet (Fig 4). The pallet satisfactorily passed this test, and no permanent deflection was observed on removal of the loads. No screws or nails lifted from the blocks.

Unit load tests

6. *Loose shunting test.* The pallet, banded as described above, was mounted on the MVEE rail shunting impact test rig (Fig 5) and subjected to three loose shunts parallel to the 43 in direction and three parallel to the 34 in direction. The speeds recorded by the electrical timing device varied between 12·5 ft/sec and 14·0 ft/sec (3·81 and 4·26 m/sec). The load had loose preventer stays attached to keep it on the rig after impact but long enough for the load to reach the maximum energy condition before falling back on its base. The diagonal bracing and top board were most effective in maintaining the integrity of the load. The only damage was sustained by the edge of the runner where it overhung the hardwood block on the line of rotation during impact (Fig 9).

7. *Careless slinging test.* The load, suspended on a crane sling, was positioned over an edge of a steel girder and allowed to come down at speed, thus simulating a load on a ship's derrick catching a hatchcombing whilst being lowered. Although the whole load was momentarily supported by one chain and the girder, no damage was sustained by the load (Fig 6).

8. *Rough terrain forklift truck test.* A course of 4 miles was successfully negotiated over steep ramps of a heavy girder bridge, sharp turns, rough and uneven track, running across ruts and with one wheel in a rut, surging backwards and forwards when bogged, and sudden stopping. Each hazard was negotiated four times. The course was completed with the forks tilted back at 10° (Figs 7 and 8).

Value engineering study

9. A critical examination was made of the design after the pallet and unit load had successfully overcome the above tests. The following action was taken:

a. The deck planks were reduced from $1\frac{1}{4}$ to 1 in (31·7 to 25·4 mm).

b. Wood screws were used only at positions where fastenings were in tension under the composite beam action. At other places $2\frac{1}{2}$ in (63·5 mm) 10 SWG ring nails were used (24 wood screws were thus saved).

c. Nine ring nails, 2 in (51 mm) long, 10 SWG, were used on each leading edge to prevent the edge from becoming detached (Fig 10).

d. The angle of chamfer was reduced to 40° to cut down the overhang beyond the blocks.

e. The plywood top board was reduced from $\frac{3}{4}$ in (18 mm) to $\frac{3}{8}$ in (9 mm).

f. The figure-of-eight banding was threaded between deck planks and the vertical ring banding holding the US pallets on to the 43 in × 34 in base.

Test of cheapened pallets

10. All the tests that were conducted on the original pallet were repeated with the cheapened pallet. The pallet showed less evidence of rough handling after completion (Fig 10) than the original pallet.

11. Director of Value Engineering has signified his approval of the steps taken to reduce the cost and of the design as it now stands.

Test to destruction

12. The pallet was supported on parallel bars under the wings, and loaded at third points along lines parallel to the support under the MVEE Test Rig. The load at failure was 10 200 lbf (4·57 kN). The components which failed were the runners which cracked along the centre (Fig 11).

Conclusions

13. The pallet, as modified for the second series of tests, adequately meets the requirements of the 30th October meeting at Bicester on the subject.

Recommendations

14. Three unit loads, consisting of 20 dummy shells on the pallet designed by MVEE, should undergo unit load test at Bicester by MHTU, who are the accepting authority for unit loads. On completion of these tests, the pallets should undergo a short User Trial at Larkhill. If this is satisfactory, it is suggested that drawings be finalised and an acceptance meeting be convened as early as possible.

15. A cheap expendable debanding tool, suggested by one of MVEE Test Gang, should be attached to each pallet. This has proved its effectiveness during development trials. The cost should be about one shilling only and its use is self-evident. (Fig 12.)

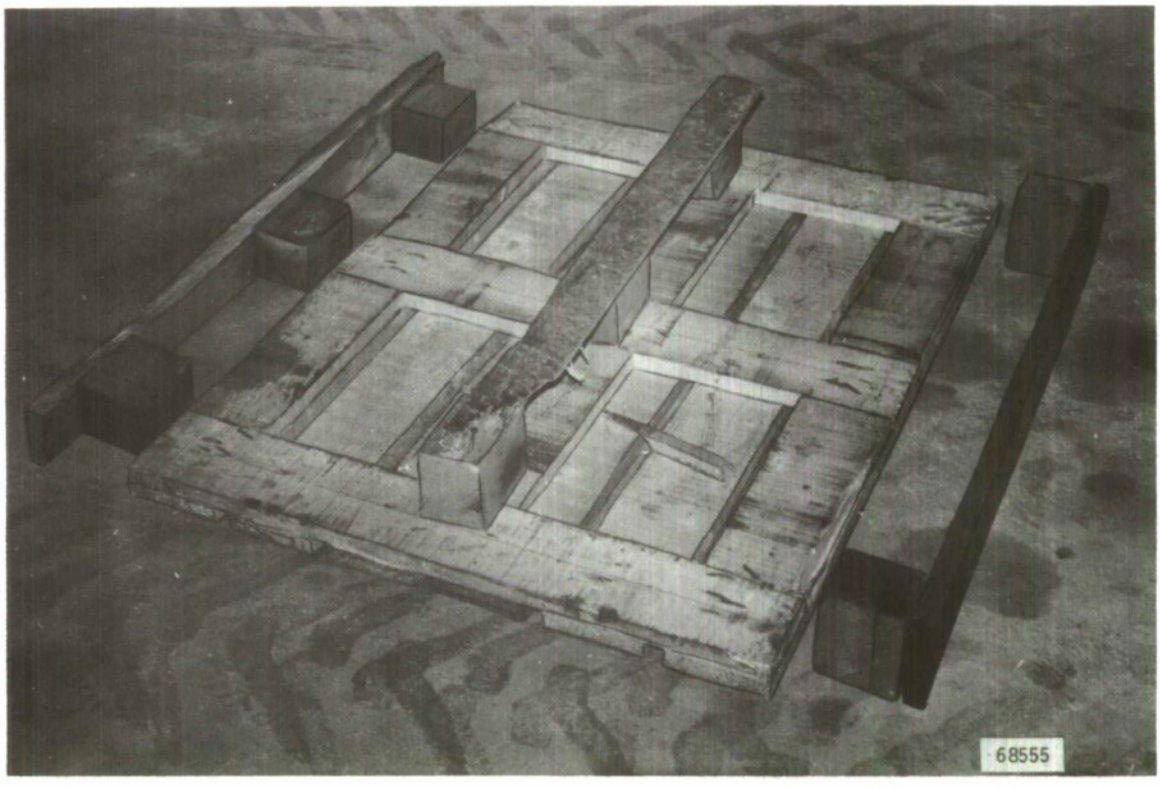

Fig 1 MHTU Pallet — Weakness at anchorages

Fig 2 MVEE Pallet and diagonally braced unit load. Note packing block to prevent banding from lifting deck plank

Fig 3

MVEE diagonally braced unit load and plywood top board

Fig 4

Unit load undergoing 100% overload when slung

Fig 5 Loose shunting test on MVEE rig. Note electrical timing device velocity at instant of impact, 14·0 feet/second

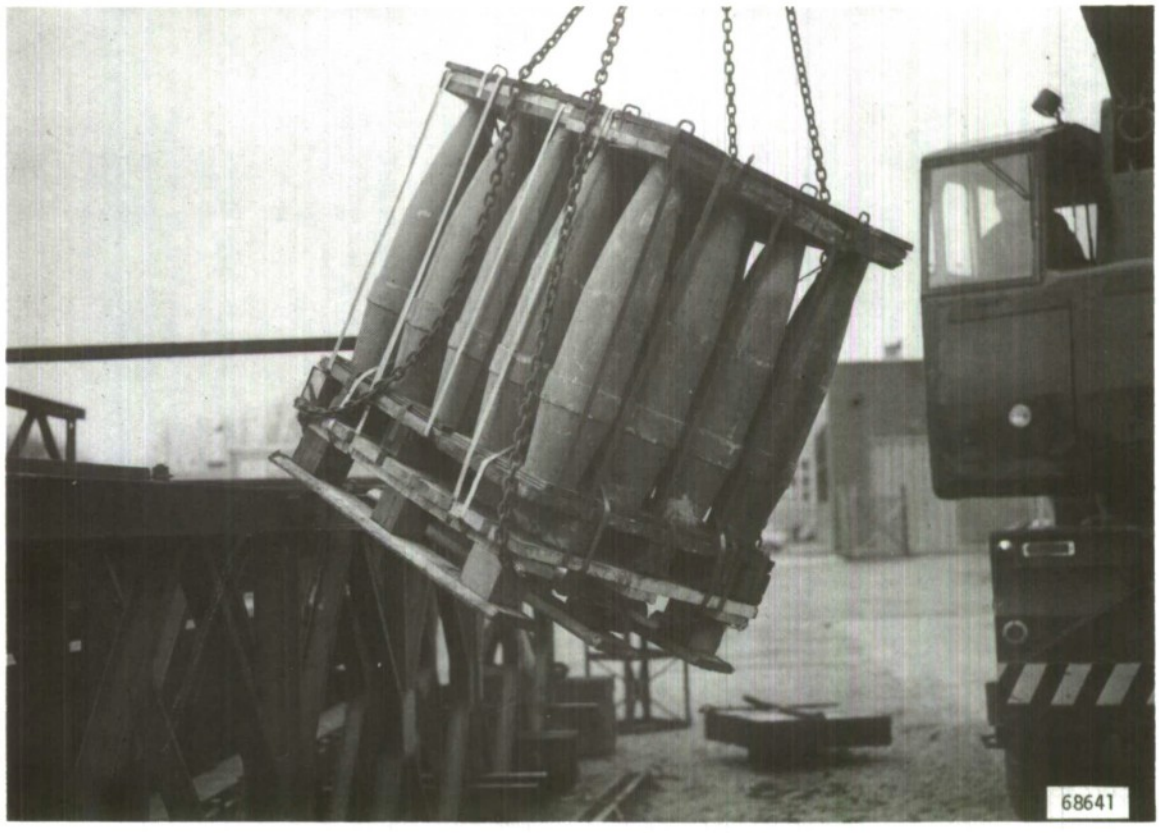

Fig 6 Careless slinging test

Fig 7 Rough terrain fork lift truck test

Fig 8 Vehicle brought to a sudden halt in a deep rut

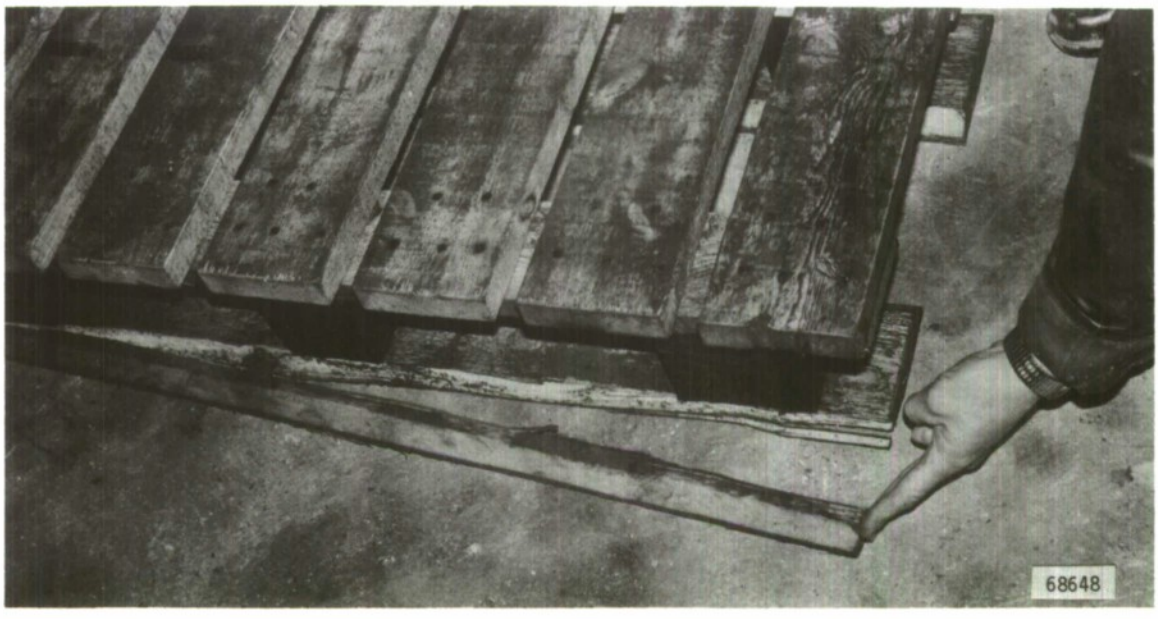

Fig 9 Edge split off runner during loose shunting test

Fig 10 Condition of unit head after all tests. Note nails holding feather edge in position

Fig 11 Failure of pallet with 10 200 lbf applied at third points, supported under the wings

Fig 12 Debanding tool

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Record Summary:

Title: 175 mm special purpose pallet
Covering dates 1970 Jan 01 - 1970 Dec 31
Availability Open Document, Open Description, Open on Transfer
Former reference (Department) Report 70518
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